How Much Pasture Do I Have and How Long Will It Feed My Cows?

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A very common question asked by cattlemen is, “How much pasture do I have and how long will it feed my cows.” The purpose of this paper is to provide some guidelines and tools for answering this question. In pasture systems, determining the amount of pasture is much harder than in grain-based feeding systems because feed may be allocated for more than one day and feed quantity and quality is influenced by weather, fertility, stand density, and season. In addition, not all the available forage is consumed and the plants continue to grow after they are grazed. Variation in quality and animal production status (pregnant, dry, lactating, growing, etc.) also influence feed consumption.

The most commonly used methods to estimate available pasture include hand clipping, grazing sticks, and rising plate and falling plate meters. In the pages that follow I will provide an outline of how a grazing stick can be used to estimate pasture yield and how to calculate pasture allocation to your herd. Remember that grazing sticks and other tools are useful for making immediate pasture management decisions, but good records of pasture yield, grazing days, and other data will provide a means to evaluate past efforts to improve the system. Records can also be used to identify areas of weakness in the system and help make plans for improvement. More specific information about grazing, pasture management, and forage species is available in other publications, such as *Rotational Grazing* (ID-143) at *www.uky.edu/Ag/Forage/ForagePublications.htm*. Other excellent resources are listed at the end of this document.

Grazing sticks are handy tools that simplify the tasks of measuring pasture yield, allocating pasture to animals, and tracking changes in productivity. These are all critical aspects of good pasture management. Grazing sticks vary somewhat from state to state. The Kentucky model consists of the following:

- A ruler to measure forage height
- A quick guide to start and stop grazing on a paddock
- A table to convert stand density to dry matter per acre inch
- Formulas for pasture allocation
- Rules of thumb and planning information

Keep in mind that grazing sticks provide only an estimate of pasture yield. If you keep good records and compare yield estimates with actual grazing days, you will be able to get closer to the actual yield for your farm and your conditions.

Determining How Much Pasture You Have

The grazing stick procedure is designed to estimate the amount of forage in a pasture. The estimate is only as good as the sample. Sample numbers are key to obtaining a good estimate. If the forage stand and the topography are uniform, a minimum of two samples per acre is recommended. At least 20 individual measurements should be averaged to estimate yield in pastures of 10 acres. A higher number of measurements should be made for fields with variable soils, topography, or forage stands.

Step 1: Use the ruler side of the grazing stick to measure the height of the forage. With most forages, plant height taller than 18-24 inches is really better suited to hay than to grazing. This is particularly true with infected tall fescue, because toxins increase with stem growth and seed head development. See *Tall Fescue Endophyte Concepts www.uky.edu/Ag/Forage/ForagePublications.htm* for more information.

Height is not a measure, but rather an average, of the tallest plants. Spread your hand and lower it onto the canopy. The average height is measured at the point where you feel very modest resistance from the plant canopy. Record the height for each sample location in the pasture and then calculate the average height for the pasture.

Step 2: Visually estimate the density of the stand by looking directly down at the spot where you have just measured canopy height and continue to do this at each location where you measure plant height. Stand density is simply the amount of the ground surface covered with standing forage (do not include residue directly on the ground, but only plant material tall enough for the livestock to consume).

Your goal is to place the pasture into one of three density categories (<75%, 75 to 90%, >90%). Record the density reading for each location where height was measured, then calculate the average stand density for the pasture. The density yield table (Table 1) can now be used to estimate forage yield per acre inch.

Note: Stand density measurements using the grazing stick are most accurate when canopy height is approximately 8 inches tall. Also, the density yield table is more accurate with denser stands. Grazing sticks used by some other states show higher forage yield per inch of growth. For the Kentucky Grazing Stick we have validated our estimations during several session s of the KY Grazing School, but we have been intentionally conservative in our yield estimations. Stands of stockpiled tall fescue tend to be much denser than those recorded on the grazing stick and are most accurately measured using plate meters or hand clipping.

Step 3: Determine the dry matter (DM) yield per inch using the density measured in Step 2. For example, if you are measuring a tall fescue pasture and you estimate that the available forage covers 85% of the ground area. This pasture would be assigned the middle density category of 75 to 90% cover and according the chart located below the density ratings would have between 150 and 200 lb of DM per acre inch (Table 1). Based on your assessment of the stand, assign a yield (the thicker the

stand the closer to the upper end of the range). Since 85% is in the upper end of this density category then 200 lb of DM per acre inch would be a good estimate. If the average stand height was 8 inches, and you want to maintain 3 inches of stubble after grazing, then available forage equals:

5 inches x 200 lb/acre inch = 1000 lb DM/acre

Step 4a: Calibration (quick estimate): A periodic check of your measurements can help you to be consistent about using the grazing stick. Harvest 1 square foot of forage (cut at soil level), weigh it in grams, and multiply by 20. This will give an estimate of lb per acre assuming the forage is 20% DM. While this method is useful for a quick check, the DM content of forage does vary throughout the year, so the yield estimate will be more accurate if the sample is actually dried.

Step 4b: Calibration (better estimate):

1. Harvest 1 square foot of forage (cut at soil level) and chop the forage into 1- to 2-inch lengths.
2. Weigh the forage (in grams) then place it on a microwave-safe dish and place the dish in a microwave oven. Place a cup of water in the microwave as well (this will reduce the risk of burning the forage).
3. Heat on high for two minutes.
4. Weigh the forage.
5. If the forage is not dry, place it back in the oven and heat it for 30 seconds.
6. Repeat steps D and E until the weight does not change. If the forage is charred, use the last weight.
7. Multiply the dry weight in grams by 100 for an estimate of dry matter yield in lbs per acre.

Table 1. Density-yield relationships to determine estimated dry matter per acre inch.

Density Category	<75%	75-90%	>90%
Tall Fescue or orchardgrass	50-150	150-200	200-300
Bluegrass	50-100	100-175	175-250
Cool-season grass-clover	50-125	125-200	200-275
Bermudagrass	100-200	200-300	300-400
Alfalfa	75-150	150-225	225-300
Red clover	75-125	125-175	175-250

Determining Pasture Allocation for your herd

The pasture system that you are using will determine the way you apportion forage to your animals. If you are using temporary electric fencing and allocating acreage to feed your animals for a specific number of days, you will need to calculate the acres needed per day. If you have a slow rotation with modest-sized paddocks, you will have to determine how many days a particular paddock will carry your herd. If you can vary animal numbers to fully utilize your available pasture, you will have to determine how many animals are required to fully utilize the available forage. Each situation requires you to use the above yield estimation to make the appropriate allocation. In addition to forage yield, the formulas require values for percent utilization (Table 2), animal weights, and animal intake (Table 3).

Utilization is defined as the percent of the available forage that animals consume. The unconsumed portion includes waste from trampling, dung, and urine. Utilization rates vary with the intensity of the grazing system (Table 2).

Animals will only use 30 to 40% of the forage on a continuously grazed pasture. This is due to the fact that they have excess forage and graze selectively. The forage that they do not eat may become mature and unpalatable. In addition, much of the available forage is trampled or fouled with dung or urine. With pasture rotation, the grazing period is shortened, animals cannot be as selective and less forage is wasted (Table 2). With a slow rotation (three to four paddocks, animals move every seven to 10 days), the utilization increases to 40 to 55% and a faster rotation will increase utilization to 55 to 70%. It is possible to achieve higher utilization (70 to 80%) with very intensive rotational systems (animals moved once or twice a day).

Table 2. Effect of grazing system on forage utilization (from the Kentucky Grazing Stick).

System	Utilization
Continuous	30-40%
Slow rotation (3-4 paddocks)	40-55%
Fast rotation (8+ paddocks)	55-70%

Livestock species, class, and physiological condition all have profound effects on intake (Table 3). Forage intake may also be influenced by plant growth stage. Mature plants have high fiber content and because fiber digests slowly, this low-quality feed can limit the amount an animal can consume. See *Understanding Forage Quality* at *www.uky.edu/Ag/Forage/ForagePublications.htm* for more detailed information. Lactating dairy cows need a high plane of nutrition to maintain high levels of milk production and, as indicated in the table, some supplementation with grain may be necessary to provide sufficient intake for these animals.

Table 3. Forage intake guidelines.

Livestock	Dry matter intake as a % body weight
Dry beef cow	2
Lactating beef cow	3-4
Lactating dairy cow	2.5-5*
Stockers	2.5-3.5
Horses	2.5-3
Sheep & goats	3.5-4
*May include grain.	

Pasture Allocation Examples Using Formulas from the Grazing Stick

Calculate: The paddock size needed to feed a set number of animals.

Example 1: 100 dry cows, average weight 1,350 lb.

$$\text{Acres required/paddock} = \frac{(\text{weight}) \times (\text{intake in \% body weight}) \times (\text{animal \#}) \times (\text{days/paddock})}{(\text{available DM/acre}) \times (\text{\% utilization})}$$

Step 1: Animals will be moved every three to five days in an eight-paddock system, so utilization is estimated to be 60% (Table 2).

Step 2: Set intake—because they are dry cows, use 2% (Table 3).

$$\frac{(1{,}350\ \text{lb/cow}) \times (0.02/\text{day}) \times (100\ \text{cows}) \times (4\ \text{days})}{(1{,}050\ \text{lb/acre}) \times (.60)} = 17.1\ \text{acres}$$

Calculate: The number of animals needed to utilize the available forage.

Example 2: The paddock size is 20 acres and the grazing period is 4 days.

$$\#\ \text{of animals required to graze a paddock} = \frac{(\text{DM/acre}) \times (\text{acres}) \times (\%\ \text{utilization})}{(\text{animal weight}) \times (\text{intake in \% body weight}) \times (\text{days})}$$

$$\frac{(1{,}050\ \text{lb/acre}) \times (20\ \text{acres}) \times (.60)}{(1{,}350\ \text{lb}) \times (.02/\text{day}) \times (4\ \text{days})}$$

= 117 cows would be needed to graze this paddock in 4 days

Calculate: The number of days a paddock will last.

Example 3: A herd of 100 cows on a fast rotation.

$$\text{Days of grazing/paddock} = \frac{(\text{DM/acre}) \times (\text{acres}) \times (\%\ \text{utilization})}{(\text{animal weight}) \times (\text{intake in \% body weight}) \times (\#\ \text{animals})}$$

$$\frac{(1{,}050\ \text{lb/acre}) \times (20\ \text{acres}) \times (.60)}{(1{,}350\ \text{lb}) \times (.02/\text{day}) \times (100\ \text{cows})}$$

= 4.6 days

The grazing stick also has a quick guide to determine when to start and stop grazing. If you carry the stick with you whenever you check animals or move fences, you can quickly assess pasture regrowth and readiness for grazing. The suggested starting height for grazing is 8 to 10 inches, which ensures that forage is in a high-quality vegetative stage. The stop-grazing limit applies to grass or grass-legume pastures. The 3 to 4 inch stubble height ensures that some leaf tissue is available for grass regrowth. Removal of basal leaves will slow grass regrowth and limit yield. If pastures are growing quickly in the spring, you may need to harvest or clip them to keep them productive and in a high-quality condition.

The guidelines for grazing vary according to the requirements for different plant species (Table 4). For example, grazing is normally delayed until bud stage for alfalfa, so that the plants can restore root reserves that were used in regrowth. Consistently grazing forages, prior to the indicated height or stage, may thin the stand. Overgrazing (too little stubble remaining after grazing) may limit pasture yield because plants do not have enough leaf tissue for photosynthesis and rapid growth. Rest periods and amount of forage removal must be carefully balanced to keep pastures productive. One of the best tools to accomplish this is frequent observation of pastures and pasture regrowth. In spring, pasture growth is often too rapid for optimum grazing, so rotations may need to be accelerated to keep pastures in good quality. During summer, cool-season plants grow more slowly and the rotations may need to be slowed down to allow full recovery from grazing. When planning grazing systems, you can calculate the number of paddocks necessary to provide a desired rest period.

Table 4. Beginning and ending grazing heights from the Kentucky Grazing Stick.

General Thumb Rules for Grazing Heights		
	Height, Inches	
Forage Type	Begin Grazing	End Grazing
Cool-season grasses and legumes other than alfalfa	8-10	3-4
Alfalfa	Bud stage	2-3
Annual warm-season grasses	20-24	8-10
Native warm-season grasses	18=22	8-10
Bermudagrass	6-8	1-2

Justification for Good Records

Grain producers determine the number of inputs to use based on the yield that they will gain from each input. The inputs and the resulting yield are easily measured, so grain production systems are quickly refined and improved. Good pasture records are slightly more difficult to collect, but they can also contribute to rapid improvement of pasture systems. One objective of pasture improvement is to increase yield, but changes in pasture management may also target herbage quality, distribution of yield, or persistence. Pasture improvements may result in improved gains, increased carrying capacity, or reduced need for supplementation during summer months. These improvements are not necessarily obvious unless producers keep good records and study them. Records will help a manager place a value on improvements and thus help decide where to spend limited resources to maximize the benefits.

Keeping Good Records

All information should be entered in a timely manner and regularly reviewed. Pasture records should include information about both inputs and outputs. General and input information should include: year, paddock identification, paddock size, monthly rainfall, date and amounts of fertilizer, seed and pesticide inputs, and the most recent soil test data. In addition, each time a paddock is grazed, record the number and average size of animals, dates in and out, pasture height at the beginning and end of grazing, yield estimate at the start of grazing, and stand density at the start of grazing.

Using Your Records for Planning

One of the most important points about

records is that they must be studied. Some people diligently keep records and then file them at the end of the season. It will take some work to compile records into a form that you can use efficiently, but this effort is worthwhile. If you are going to keep records, then commit yourself to using them. Here are a few examples of questions that might be answered by studying your pasture records:

- How much did legumes increase animal grazing days per acre in the summer?
- How much did fertilizer improve animal grazing days per acre?
- Which pastures and forages performed best in a dry year?
- How severe is the summer slump? Do you need to increase production during this period?
- Are your pastures improving or declining? Do you need to increase or decrease stock density?
- Did your stockpile run out before spring growth began? How many more acres of stockpile do you need to support the herd? Can you fill gaps in forage production by grazing crop residues?
- Did your pasture management improvements result in reduced costs, or increased carrying capacity, or better gains?

The following is a selection of the publications available online at www.uky.edu/Ag/Forage/ForagePublications.htm.

- ID-74—*Planning Fencing Systems for Intensive Grazing Management*
- ID-97—*Grazing Alfalfa*
- ID-143—*Rotational Grazing*
- PPA-30—*Sampling for the Tall Fescue Endophyte in Pasture or Hay Stands*

Additional Useful References

One of the best references for determining forage production is Chapter 16 of the new publication "Pasture and Grazing Management in the Northwest." It contains step by step guidelines on the clipping method and other methods to estimate pasture productivity. It is now available on-line (http://www.cals.uidaho.edu/edComm/detail.asp?IDnum=1586) or a hard copy can be ordered by calling 1-800-723-1763 or on the website http://pubs.wsu.edu.